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[0001] PAPER JAM DETECTOR FOR AUTOMATIC FOOD PROCESSING LINE

[0002] CROSS-REFERENCE TO RELATED APPLICATIONS

[0003] This application claims the benefit of U.S. Provisional Patent Application No. 60/257,560, filed December 22, 2000.

[0004] BACKGROUND

[0005] The present invention relates generally to interleaving devices used in food preparation lines. More particularly, the invention relates to a method for detecting paper jams on automated food processing lines and allowing rapid service without the need for shutting down the entire line.

[0006] Automated food processing machines have become prevalent in the art for interleaving and stacking food products. Food processing machines may produce sliced meat hamburger patties or other types of food which can then be arranged in a designated pattern on a substrate which is then stacked and packaged. Products handled in this manner include sandwich meats, cheese, steak meat, hamburger, pizza, pasta, dough products, as well as other food which can then be easily accessed in a predetermined quantity by a food preparer who can simply unload the set-up during the food preparation process. Typically, interleaved products have particular weights of a food serving located on a substrate. Automated equipment for preparing interleaved products is known, and may include different food slicing, extruding or other handling equipment which creates the predetermined quantity of food. The food is then carried to an interleaver where it is placed upon the predetermined length of a substrate, such as a separating paper, to form the interleaved product. From there, further equipment takes the interleaved product on the predetermined length of paper to a

stacking machine for stacking and packaging. Such equipment may run at speeds of 50-250 set-ups per minute, depending upon the food being packaged. For example, hamburger patties are typically run at approximately 80 to 320 interleaved products per minute in a single lane or multi lane operation. Minute steaks can be processed at a speed of 240 interleaved products per minute, depending upon the particular equipment being utilized. Typically the processing equipment is fully automated such that only one operator may be able to monitor the production of several food lines at the same time.

[0007] A known problem with the existing interleavers for placing the predetermined length of separating paper under the food product is that sometimes the automatic paper feeding mechanism jams. Since the food processing line operates at high speed, in the time it takes to detect that food product is being dispensed from the product line without the required separating paper, the paper feed may have already attempted to insert 15-20 additional sheets of paper creating a hard jam in the interleaver equipment feed. The entire product line must then be shut down for 10-15 minutes while an operator clears the multiple sheets of paper jammed in the interleaver feed path. Additionally, this can result in damage to the interleaver feed rolls as the paper jam is cleared, since operators typically use a screw driver or other blunt instrument to pry the paper out. An additional problem caused by the delay is that the batch of food being processed may have to be discarded, depending on the delay time. It would therefore be desirable to have a faster and easier way to detect paper jams in the interleaver and clear the paper jams once they are detected.

[0008] SUMMARY

[0009] The present invention provides an interleaver having a susbtrate jam detector. The interleaver includes first and second conveyors, with the first conveyor feeding a product onto the second conveyor. A substrate feed mechanism is provided having a feed path

positioned to insert a predetermined length of substrate between the first and second conveyors and onto the second conveyor such that the substrate is located under the product as the product is transferred from the first conveyor to the second conveyor. At least one jam detector sensor is located along at least one of the feed path from the substrate feed mechanism and the second conveyor, and is adapted to detect when a substrate passes from the substrate feed mechanism onto the second conveyor. A controller is connected to the at least one jam detector sensor and to the substrate feed mechanism such that upon detection of an unsuccessful substrate feed, the controller turns off the substrate feed mechanism. Because the jam detector shuts down the substrate feed mechanism as soon as a jam is detected, an operator can easily clear a one to two sheet jam from the interleaver feed mechanism at a much faster rate than in the prior known equipment where the substrate feeder continued to jam additional sheets of substrate into the feed opening. This prevents damage to the feed rolls, paper wire guides, and other machine components.

[0010] In another aspect, the invention provides a method of detecting a jam in a substrate interleaver for products traveling along a conveyor path. The method includes: (a) providing first and second conveyors, the first conveyor adapted to feed a product onto the second conveyor; (b) positioning a jam detector sensor along at least one of a substrate feed path of a substrate feed mechanism positioned to insert substrates under product being conveyed by the first conveyor to the second conveyor and the second conveyor; (c) detecting a product traveling along the first conveyor and initiating a substrate feed sequence from the substrate feed mechanism; (d) sensing at least one of a substrate leading edge passing the jam detector sensor within a predetermined time, a continuous blockage of the jam detector sensor, and a substrate trailing edge passing the jam detector sensor within a second predetermined time; and (e) turning off the substrate feed mechanism in the event that a jam is detected.

[0011] BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The following detailed description of the preferred embodiments of the present invention will be better understood when read in conjunction with the appended drawings. For the purposes of illustrating the invention, there is shown in the drawings embodiments which are presently preferred. It is understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown.

[0013] Figure 1 is an elevational view of an interleaver having a jam detector in accordance with the present invention.

[0014] Figure 2 is a top plan view of the interleaver in accordance with Figure 1.

[0015] Figure 3 is a right side elevational view of the interleaver in accordance with Figure 1.

[0016] Figure 4 is a greatly enlarged detail of a portion of the interleaver indicated in Figure 1, showing the jam detector sensors.

[0017] Figure 5 is a cross-sectional view of the conveyor taking along lines 5-5 in Figure 3.

[0018] Figure 6 is a top plan view of the conveyor shown in Figure 5.

[0019] Figure 7 is a right side elevational view of the conveyor shown in Figure 5.

[0020] Figures 8A through 8C are a flow diagram of the logic for the paper jam detector utilized with the interleaver in accordance with a first preferred embodiment of the present invention.

[0021] Figure 9 is an elevational view similar to Figure 4, showing a jam detector sensor in accordance with a second preferred embodiment of the present invention.

[0022] Figures 10A through 10C are a flow diagram of the logic for the paper jam detector utilized with the interleaver in accordance with a second preferred embodiment of the present invention.

[0023] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Referring now to Figures 1-3, an interleaver 10 for use in connection with an automated food production line in which a food product is placed upon a separating paper substrate is shown. The interleaver 10 includes a first product conveyor 12 and a second product conveyor 14 which are supported on a frame 16. As shown in Figure 1, preferably the first conveyor 12 is located at a slightly higher elevation than the second conveyor 14. A substrate feed mechanism 20 is located between the first and second conveyors 12, 14. A paper jam detector 40 in accordance with a first embodiment of the present invention is mounted below the second conveyor 14. Product is carried in the product flow direction, indicated by arrow 18 in Figure 1, on the first conveyor 12. As each product passes from the first conveyor 12 to the second conveyor 14, a substrate 13, such as a piece of wax paper or any other suitable material, is introduced onto the surface of the second conveyor 14 underneath the product such that the product is located on the substrate 13. The product/substrate food set-up is then carried from the second conveyor 14 for further processing, stacking or packaging.

[0025] Referring now to Figure 4, the paper feed path 22 of the substrate feed mechanism 20 is shown in detail. The paper feed path is defined by a plurality of feed rollers and includes a first roller pair 24 which pulls the substrate, such as paper, from a continuous roll (not shown) into the paper feeder 20. The paper then passes between a pair of cutter rolls 25, 26 which cut a line of perforations through the continuous roll of feed stock to allow separation of a paper substrate 13 of a desired length for each food product being conveyed to form the food set-up. The substrate 13 then passes between a pair of acceleration rolls 27 which rotate at a higher speed than the cutter rolls 25, 26 and the feed rolls 24. The high speed rolls 27 accelerate the portion of the paper substrate 13 above the perforation line, parting the desired length of paper substrate 13 at the separation line such that the paper

substrate 13 of the desired length is advanced through the space between the first conveyor 12 and the second conveyor 14. Alternatively, the feed rolls 24 can be stopped to cause the paper substrate 13 to part along the perforation line, parting the desired length of substrate. The paper feed mechanism 20 is controlled by a controller such that a paper substrate 13 is introduced onto the surface of the second conveyor 14 as the food product is delivered from the first conveyor 12 to the second conveyor 14, such that the food product is placed on the substrate 13.

[0026] Referring now to Figures 4-7, the jam detector 40 in accordance with the first embodiment of the invention preferably includes four photo-eye detectors 42a, 42b, 42c, 42d which are located beneath the surface of the second conveyor 14, preferably by approximately 0.5 inches, as shown in Figure 5. In the illustrated embodiment, the interleaver 10 is arranged such that four adjacent paper substrates 13 are interleaved at the same time beneath four adjacent food products being carried along the first conveyor 12. Each food product is placed upon one of the substrates 13 as the food products are transferred from the first conveyor 12 to the second conveyor 14. One photo-eye detector 42a-42d is provided for each lane of food products traveling along the interleaver 10. The photo-eye detectors 42a-42d are connected via wires, fiber optic cables or any other suitable connections 44a-44d to a controller 48. The detectors are preferably a Banner Photo-eye Mini-beam Sensor, such as Model No. SM312FVG. However, it will be recognized by those skilled in the art from the present disclosure that other types of sensors may be utilized. Additionally, the number of sensors may vary, depending upon the number of lanes of food product being carried by the conveyors 12, 14. The photo-eye 42a-42d is positioned such that it can detect whether a paper substrate 13 is present at a given time based upon the time that a paper substrate 13 is fed from the feed mechanism 20. In the event that the paper substrate 13 is not detected within a predetermined time period or count, the controller 48

signals the feed mechanism 20 to stop feeding additional paper substrates 13 to the second conveyor 14. The conveyors 12 and 14 are allowed to continue to run, and food product which passes through the interleaver 10 without a substrate 13 is removed from the automated food line in a down stream quality control area. Because the interleaver 10 detects whether each substrate 13 has been received on the second conveyor 14 within a predetermined time period, in the event that a paper substrate 13 becomes jammed in the feed mechanism 20 in the space between the conveyors 12, 14, no additional substrates 13 are forced into the jam area. Once a jam is detected by one of the photo-eye detectors 42a-42d, an alarm signal is also triggered so that an operator can clear the jam and reset the paper feed mechanism 20 such that the interleaving of paper substrates 13 under a food product can be continued with a minimum interruption of the automated food processing line. Additionally, the jam detect signal can be used to shut-off upstream equipment, if desired.

[0027] It will be recognized by those skilled in the art from the present disclosure that more or less photo-eye detectors 42a-42d may be provided depending upon the number of lanes of food product being carried by the interleaver 10. It will be similarly recognized by those skilled in the art that the photo-eye detectors 42a-42d could also be placed above the acceleration rollers 27 in the area where jams occur to directly detect a jam, as described in detail below in connection with the second preferred embodiment of the invention, instead of detecting the absence of a paper substrate 13 on the second conveyor 14, as in the first preferred embodiment described above.

[0028] Referring now to Figures 8a-8c, a logic flow diagram for the jam detector 40 in accordance with a first embodiment of the present invention is shown. As shown in box 50, the jam detector may be turned on or bypassed. If the jam detector 40 is off, the interleaver 10 may be started as shown in box 52, and product flow can begin as shown in box 54. The product detection photo-eye is activated, as shown in box 56. The product

detection photo-eye is used as a timing trigger for the paper feed sequence, as shown in box 58. Running the interleaver 10 without the jam detector 40 turned on allows for operation in the prior known manner, with the product photo-eye signal, shown in box 56, activating the paper feed sequence, as shown in box 58, such that a substrate 13 is placed under each food product as it is conveyed from the first conveyor 12 to the second conveyor 14.

[0029] When the jam detector 40 is turned on, a jam reset count is set, as shown in box 60. The jam reset count is a count signal which times when a substrate 13 is detected by the jam detector photo-eyes 42a-42d after a substrate 13 has been fed by the sheet feeder 20. It is also possible to enter the number of jam detect photo-eyes 42a-42d which are to be activated, as shown in box 62. All jam detect photo-eyes 42a-42d may be activated, as shown in box 64. However, if selected jam eyes 42a-42d are not activated, they are disabled by the control logic, as shown in the box 66. It is also necessary to position the eyes 42a-42d for the number of product lanes, as shown in box 68, and to load paper into the interleaver paper feed mechanism 20, as shown in box 70. The interleaver 10 is then started, as shown in box 72, and product flow begins, as shown in box 74. Product traveling down the first conveyor 12 activates the product photo-eye, as shown in box 76. The controller then automatically runs a self diagnostic on the jam detect photo-eyes 42a-42d to determine if they have been blocked by product for more than two seconds, as shown in box 78. While two seconds has been selected here, it is merely exemplary. If the jam detect photo-eyes 42a-42d are blocked, for example by food products which has fallen through the conveyor and onto the jam detect photo-eyes 42a-42d, the program turns off the paper feed as indicated in box 80, while the conveyors 12, 14 continue to run. An alarm is activated, as indicated in box 82, and an operator is required to manually clear the photo-eye 42a-42d, as indicated in the box 84. The jam detect signal could also be used to turn off upstream equipment, if desired. The jam detector is then reset as indicated in box 86. If it is determined that the jam

detect photo-eyes 42a-42d are not blocked during the self diagnostic shown in box 78, the paper feed sequence is initiated, as shown in box 88, based upon the signal received from the product activated paper feed photo-eye, as shown in box 76. At that point, the jam detect photo-eyes 42a-42d scan for the substrate fed by the paper feed mechanism 20, as shown in box 90. As shown in box 92, if all of the jam detect photo-eyes 42a-42d that are active sense the paper substrate, the jam detector counter is reset as shown in box 94 and the process is repeated. If all of the jam detect photo-eyes 42a-42d do not sense a substrate at the same time for each of the lanes of food product, the jam reset counter determines if the predetermined count has been exceeded, as shown in box 96. If the count has not been exceeded and a substrate is detected by each jam detect photo-eye 42a-42d within a given count, the jam detector counter is reset and the process is repeated for the next product or products in the product lanes which reach the product detection photo-eyes. In the event that the jam reset counter is exceeded, the controller 48 turns off the paper feed mechanism 20, as shown in box 80, and activates an alarm, as shown in box 82, such than an operator can clear the paper jam, as shown in box 84, before resetting the jam detector, as shown in box 86. The logic is carried out in the jam detector controller 48, which can be a PLC or any other suitable programmable controller.

[0030] Referring now to Figure 9, a second embodiment of a jam detector 140 for use in an interleaver 10 in accordance with the present invention is shown. The second embodiment of the jam detector 140 is similar to the first embodiment 40, except that the jam detect sensor 142 is formed by the end of a fiber optic cable 143 which can be positioned along the paper path to place the jam detector sensor 142 between the perforating rolls 25, 26 and the acceleration rolls 27. The fiber optic cable 143 is mounted on a bracket 145, and the paper is remotely sensed via the fiber optic cable 143, which is connected to the controller 148. This allows greater flexibility to place a sensor in almost any location,

regardless of the small spaces available. While only a single jam detect sensor 142 is shown, multiple jam detect sensors 142 and associated fiber optic cables 143 could be utilized, depending on the number of product lines being run. The fiber optic cable 143 can be a single optic fiber, or multiple optic fibers. Alternatively, a combination of electrical and optic cables or other signal transmission means could be utilized, or other types of optic sensors could be used that provide an electrical signal that is transmitted to the controller 148.

[0031] Referring now to Figures 10a-10c, a logic flow diagram for the jam detector 140 in accordance with a second embodiment of the present invention is shown. As shown in box 150, the jam detector may be turned on or bypassed. If the jam detector 140 is off, the interleaver 10 may be started as shown in box 152, and product flow can begin as shown in box 154. The product detection photo-eye is activated, as shown in box 156. The product detection photo-eye is used as a timing trigger for the paper feed sequence, as shown in box 158. Running the interleaver 10 without the jam detector 140 turned on allows for operation in the prior known manner, as discussed above in connection with the first embodiment.

[0032] When the jam detector 140 is turned on, the interleaver 10 is started, as shown in box 160. The jam detector 140 then senses whether the jam detector eye remains blocked for a predetermined interval, for example 2 seconds, as shown in box 162. If it remains blocked, the program turns off the paper feed as indicated in box 180 in Figure 10C, while the conveyors 12, 14 continue to run. An alarm is activated, as indicated in box 182, and an operator is required to manually clear the jam, as indicated in the box 184. The jam detector is then reset as indicated in box 186. Optionally, the jam detect signal can be used to turn off upstream equipment feeding the interleaver.

[0033] If it is determined that the jam detect eye 142 is not blocked, product flow is initiated, as shown in box 164 in Figure 10A. Product traveling down the first conveyor 12

activates the product photo-eye, as shown in box 166, and initiates the paper feed sequence, as shown in box 168. As shown in box 170, when the product photo-eye is activated and the paper feed sequence is initiated, an internal PLC latch is set, and a timer starts timing a predetermined time delay, as shown in box 172 in Figure 10B. If the leading edge of the paper substrate 13 is not detected within this predetermined time by the jam detect eye 142, as shown in box 174, this is considered a jam, and the sequence in boxes 182, 184, 186 and 188 is initiated. If the leading edge of the substrate 13 is detected, then the internal PLC latch is unlatched, as shown in box 176. At the conclusion of the paper feed sequence, as shown in box 177, an internal PLC latch is set, as shown in box 178, and an internal timer starts timing a predetermined time delay, as shown in box 179. If the trailing edge of the paper substrate 13 is not detected within this predetermined time delay period, as shown in box 180, this is again considered a jam, and the jam sequence is initiated. If the passing of the trailing edge of the substrate 13 is detected, the sequence is reinitiated, as indicated, when the next product activates the paper photo-eye 166.

[0034] By detecting jams in three ways: a continual blockage of the jam detect eye 142, a leading edge detection failure, or a trailing edge detection failure for each substrate, the jam detector 140 provides the ability to detect a jam after only a single piece of substrate is fed (or mis-fed) to create a jam. This allows for less down time to clear the jam, and a swift return to normal operation.

[0035] By utilizing the present invention, down time and lost product are avoided since the product in the automated food processing line is allowed to continue to flow and an alarm is immediately activated upon detection of a substrate jam in the paper feed mechanism 20. This allows an operator to quickly and easily clear a paper jam and restart the paper feed in a short time period such that the batch of food product being processed and placed on the paper substrates 13 does not have to be scrapped due to excessive down time

to clear large paper jams in the paper feed mechanism 20, which was common in the prior art interleavers. Products which continue through the food processing line without a paper substrate 13 are handled in the normal manner for rejects.

[0036] While the preferred embodiments of the invention have been described in detail, the invention is not limited to the specific embodiments described above, which should be considered as merely exemplary. Further modifications and extensions of the present invention may be developed, and all such modifications are deemed to be within the scope of the present invention.

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